

STAR Forward π^0 Detector Upgrade

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For STAR Collaboration



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Physics of FPD

Forward rapidity

$$3.0 < \eta < 4.0$$

High energy

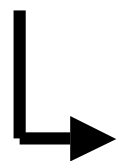
$$20 \text{ GeV} < E$$

High x_F

$$0.2 < x_F$$

Moderate p_T

$$1 < p_T < 4 \text{ GeV}$$



High x quarks (with high polarization?)

Low x gluons

- A_N measurements for $p \uparrow p \rightarrow \pi^0 + X$ (or other spin effects)
- Tuning STAR Spin Rotators required for A_{LL}
- Gluon density in heavy nuclei: $d + Au \rightarrow \pi^0 + X$

Transverse Spin Physics

E704 A_N “Mystery”

Transversity * Collins-Heppelmann Fragmentation Function?

Sivers Effect (initial state k_T & spin effect) ?

Twist-3 gluon correlations?

Others?

Semi-inclusive pDIS (Hermes, Compass, JLAB)

Transversity at pp (Star, Phenix)

jet fragmentation (+ B-factory)

DY and A_{TT} (+ RHIC luminosity upgrade?)

Mid rapidity A_N (Star) (J. Balewski's talk)


Forward rapidity charged particle A_N (Star) (J. Kiryluk's talk)

Forward rapidity high x_F π^0 A_N (Star) (G. Rakness's talk)

1 week beam with transverse spin planned for next year RHIC run

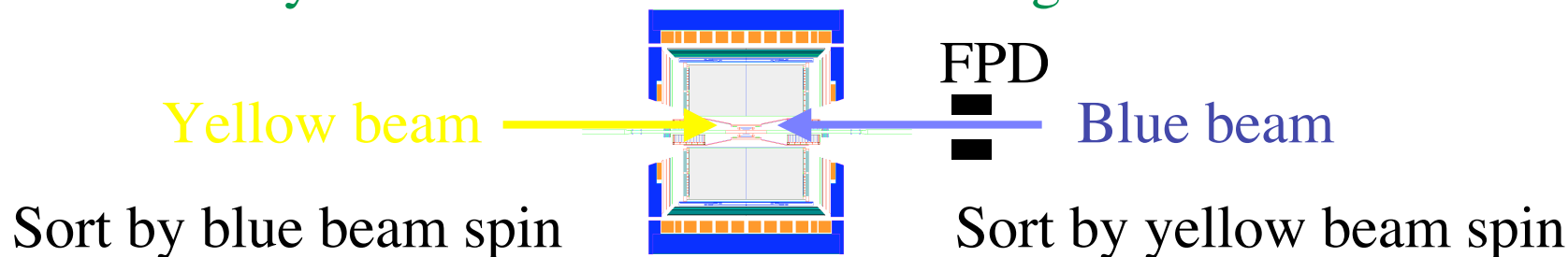
What can we do (more) with FPD?

- Continue the measurement
 - Polarization increase by factor ~ 2 (0.2 to 0.4)
 - Luminosity increase by factor ~ 10 (10^{30} to $10^{31}/\text{cm}^2/\text{s}$)
 - F.o.M = P^2L for A_N increase by ~ 40
 - Whole last year data set = a fill
 - More robust measurements with symmetric detectors
 - Charged particle coverage with BBC upgrade & FTPC
 - Negative x_F Limited statistics from last year data
 - Twist 3 effects?
 - Correlate with mid rapidity
 - We see away side correlation
 - More handle on kinematics
 - Measurement at $\sqrt{s}=500\text{GeV}$

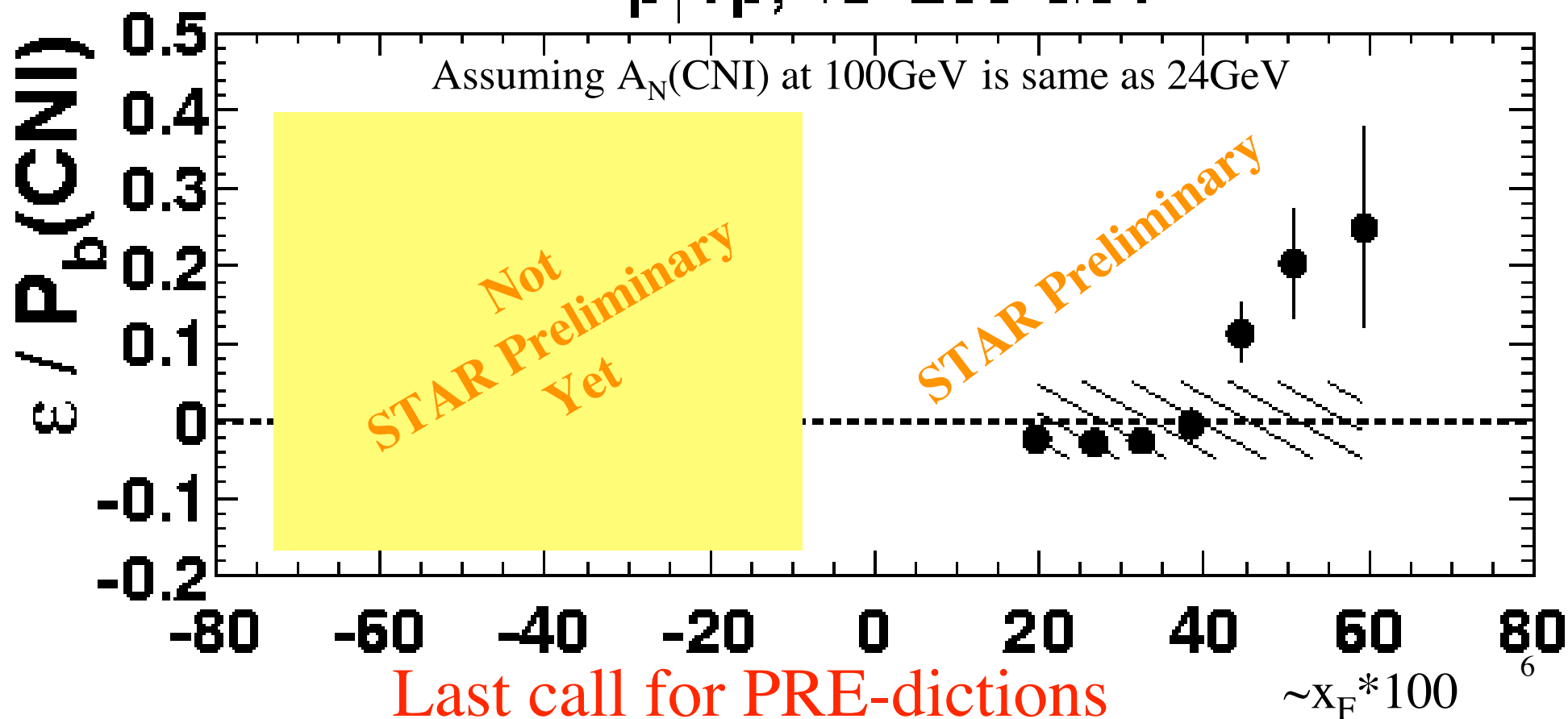

- Clues for physics behind?

A_N at negative x_F

Will it be really zero? Or will we see twist-3 gluon correlations?

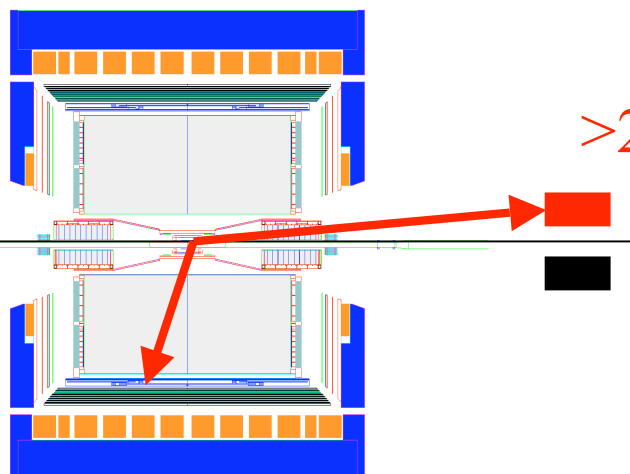


$p \uparrow + p, \sqrt{s}=200 \text{ GeV}$



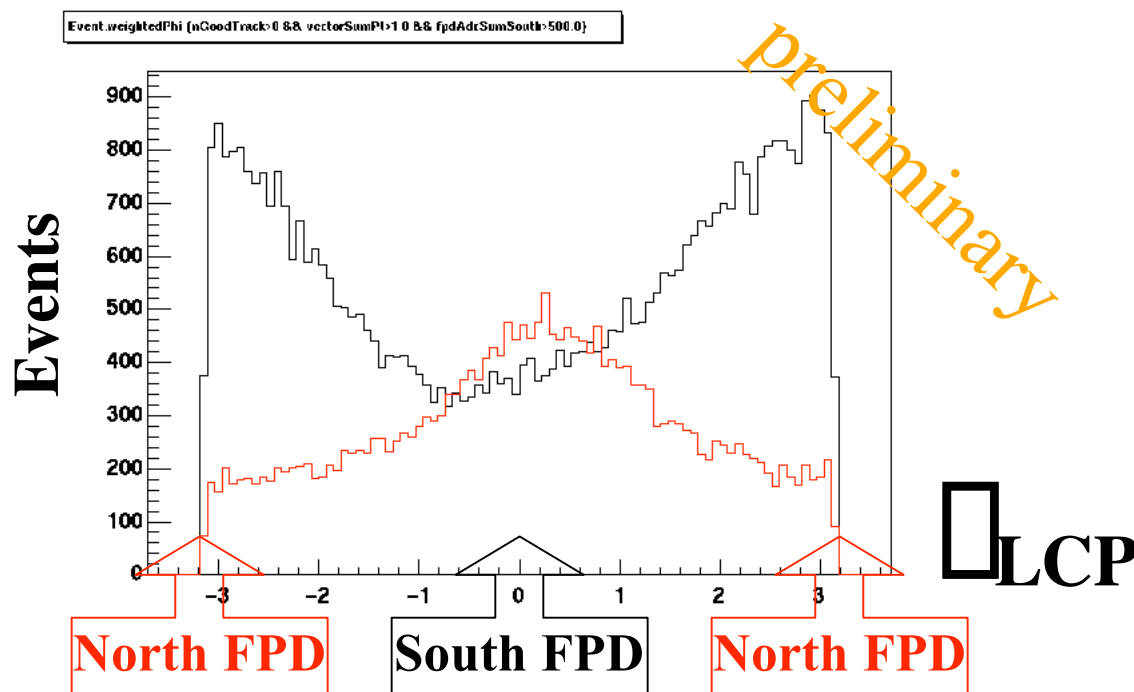
Away side of FPD

North($\eta=0$)
 \uparrow
 South($\eta=0$)



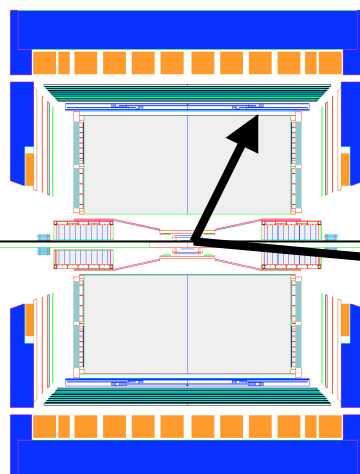
$>20\text{GeV}$ at North FPD

Leading charged particles
 of $p_t > 1\text{GeV}$
 in mid rapidity TPC



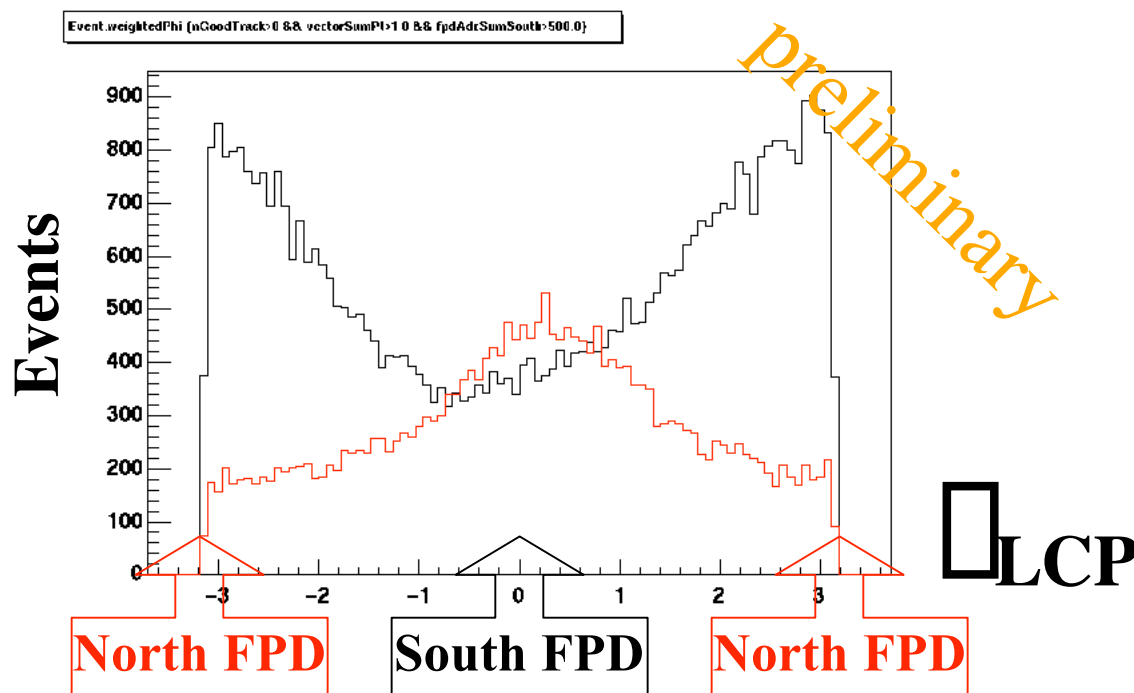
Away side of FPD

North($\eta=0$)
 \uparrow
 South($\eta=0$)



Leading charged particles
 of $pt > 1 \text{ GeV}$
 in mid rapidity TPC

$> 16 \text{ GeV}$ at South FPD

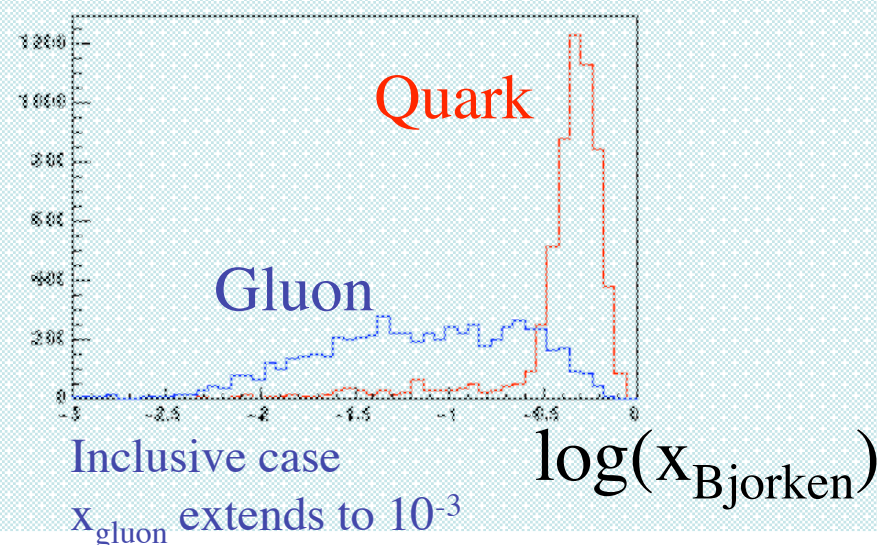
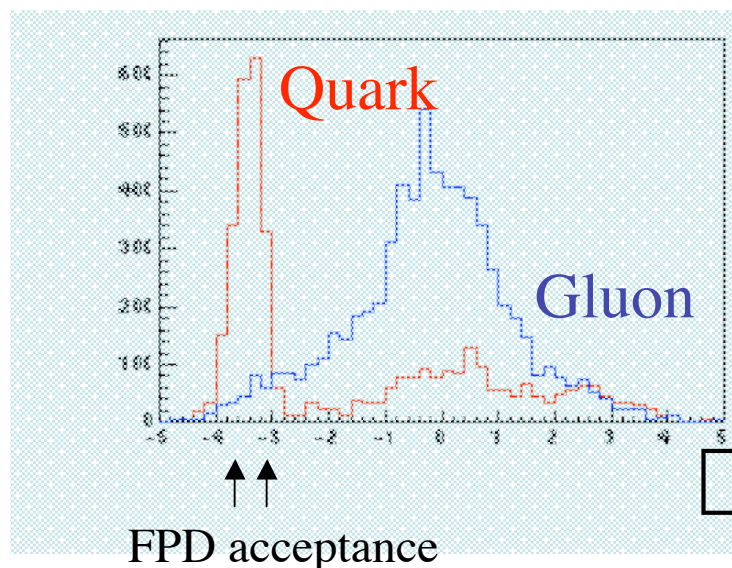
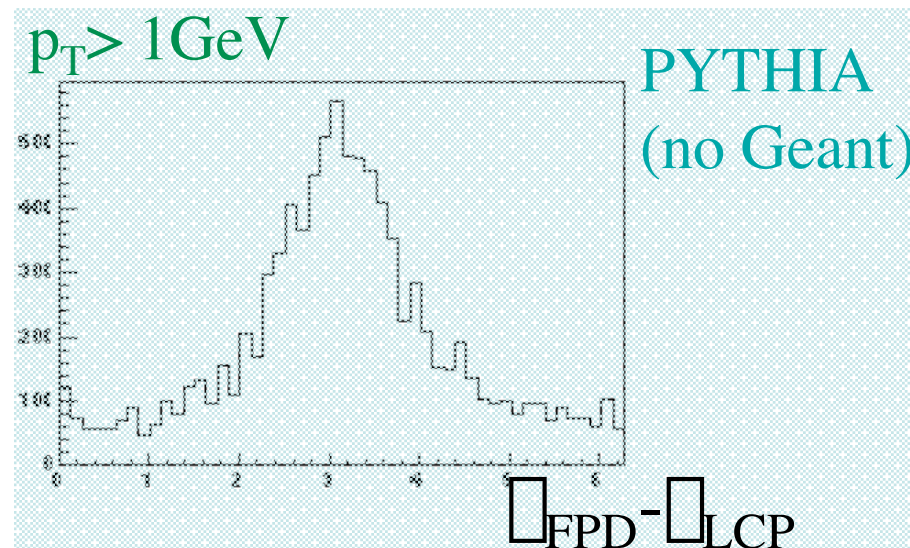
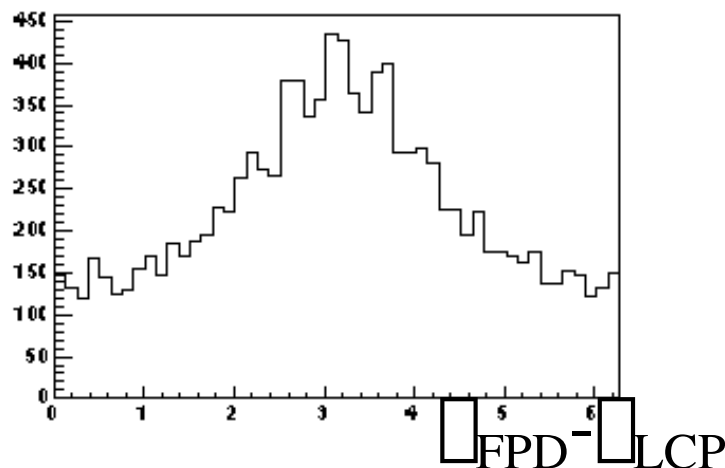


What are we looking at?

FPD North ($3 < \eta < 3.4$) $E > 25 \text{ GeV}$ ($p_T > 2 \text{ GeV}$)

and LCP $p_T > 1 \text{ GeV}$

STAR
Data



More handles on kinematics

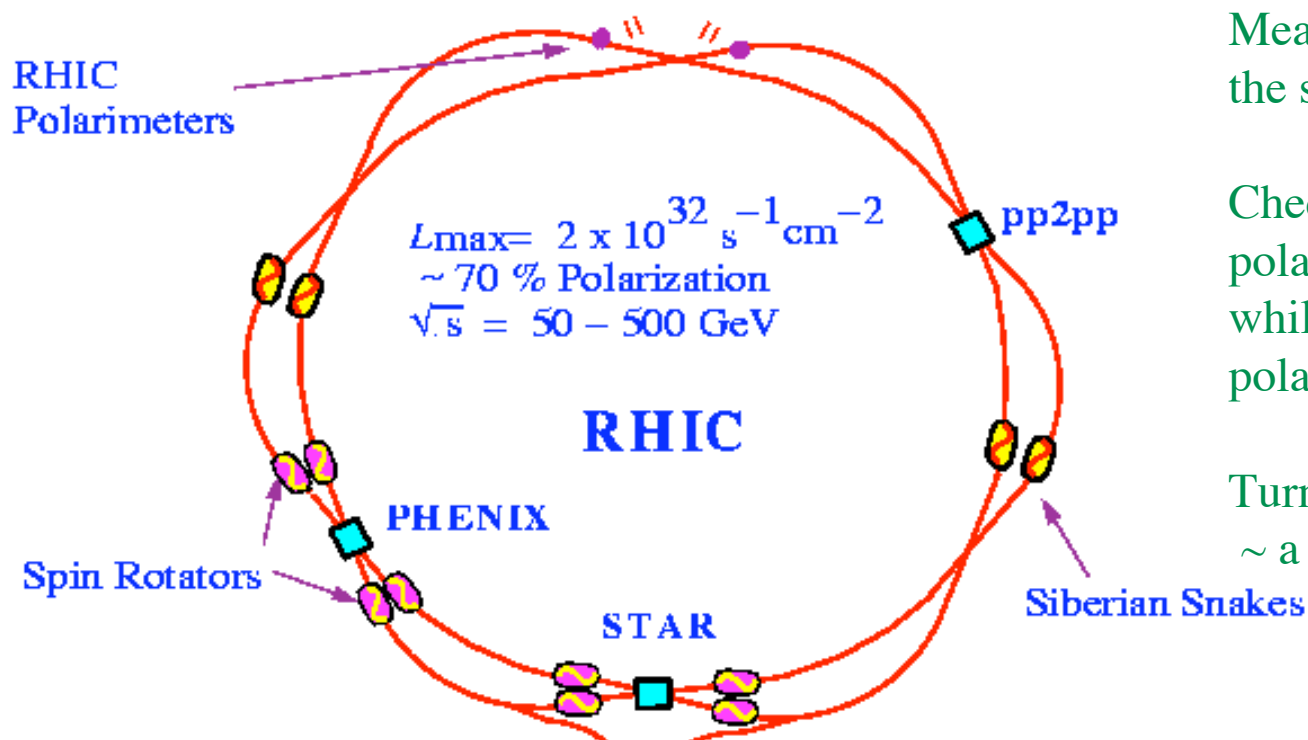
Tuning STAR Spin Rotators

Spin Rotators to make polarization from vertical to longitudinal and back

- Very complex polarization dynamics through spin rotators
- It's (supposed to be) Transparent to the rest of the RHIC ring

↳ Requires a local polarimeter

Polarized Proton Collisions at BNL



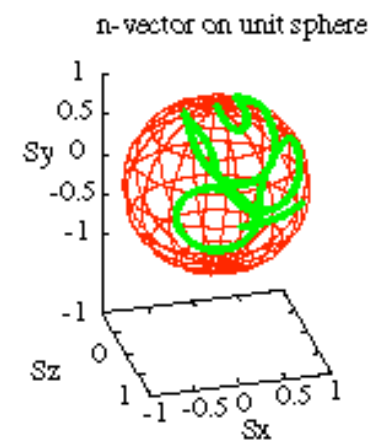
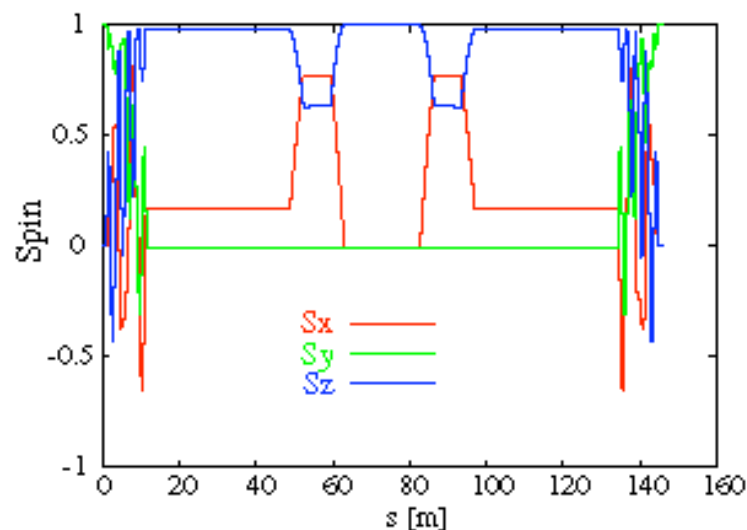
Measure A_N as RHIC tune the spin rotators

Check vertical and radial polarization goes zero, while no change at CNI polarimeter.

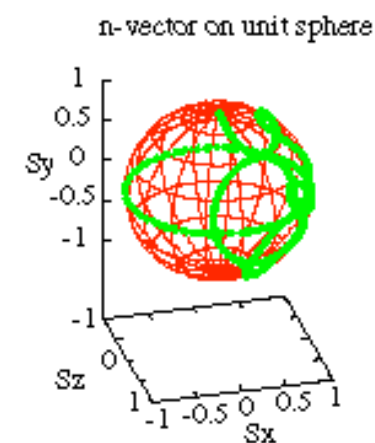
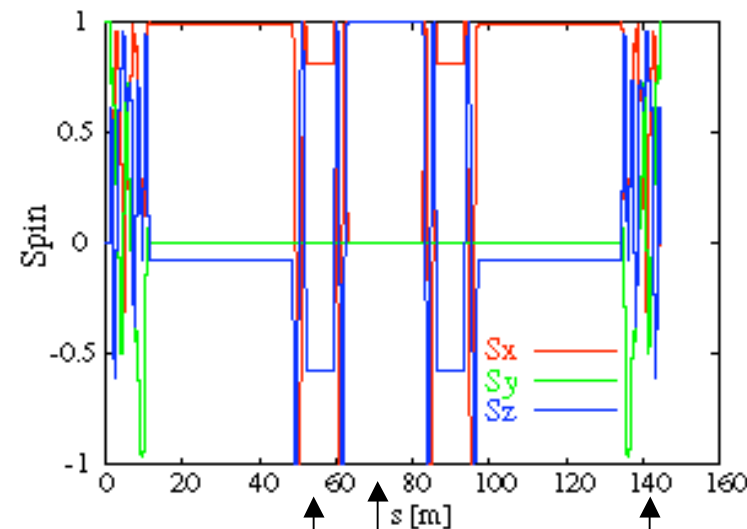
Turn around time :
~ a couple of hours to a fill

Spin Motion at STAR

STAR at injection



STAR at 250 GeV



Steering magnets

STAR IR

Spin Rotator

Waldo MacKay
RHIC Retreat
5 March, 2002

FPD Upgrade

Left-right detectors 7 by 7 Pb-G array with SMD & Pre-Shower

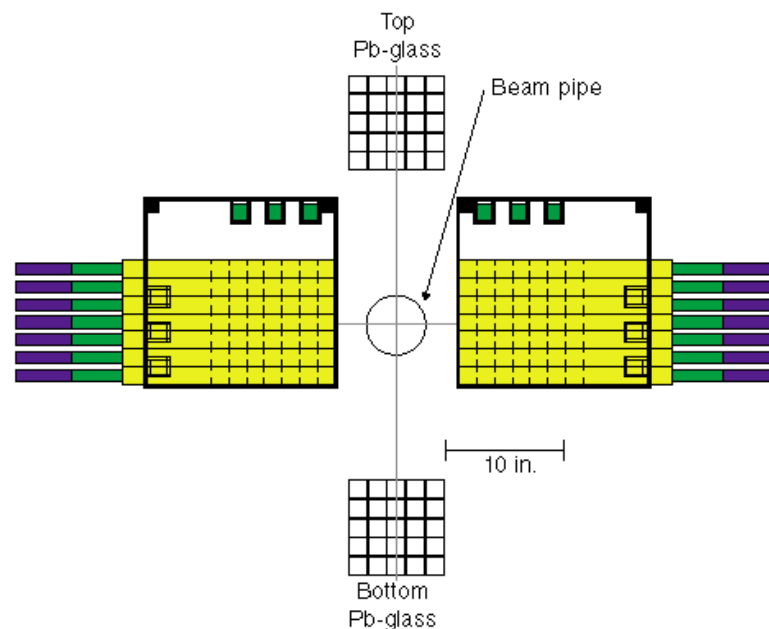
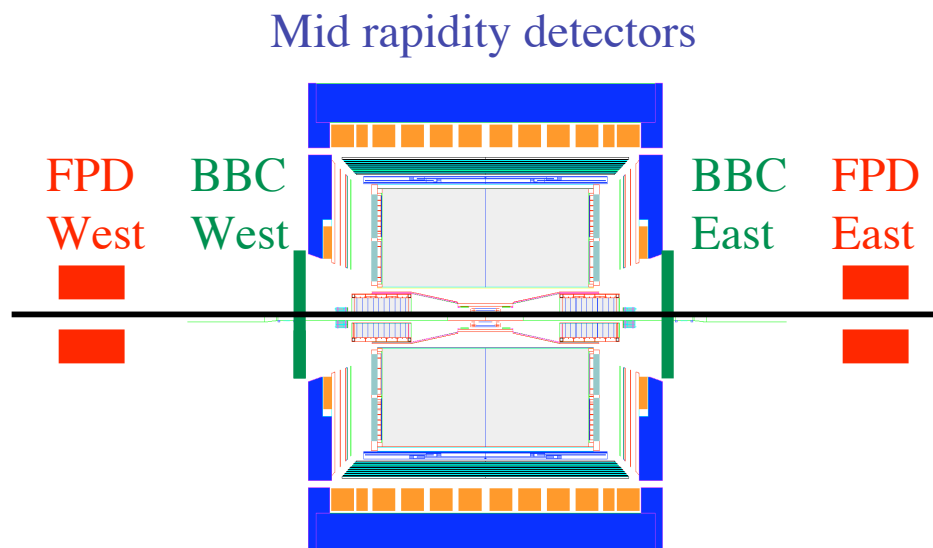
Top-bottom detectors 5 by 5 Pb-G array

Total 324 Pb-Glass from Protovino (Used in E704)

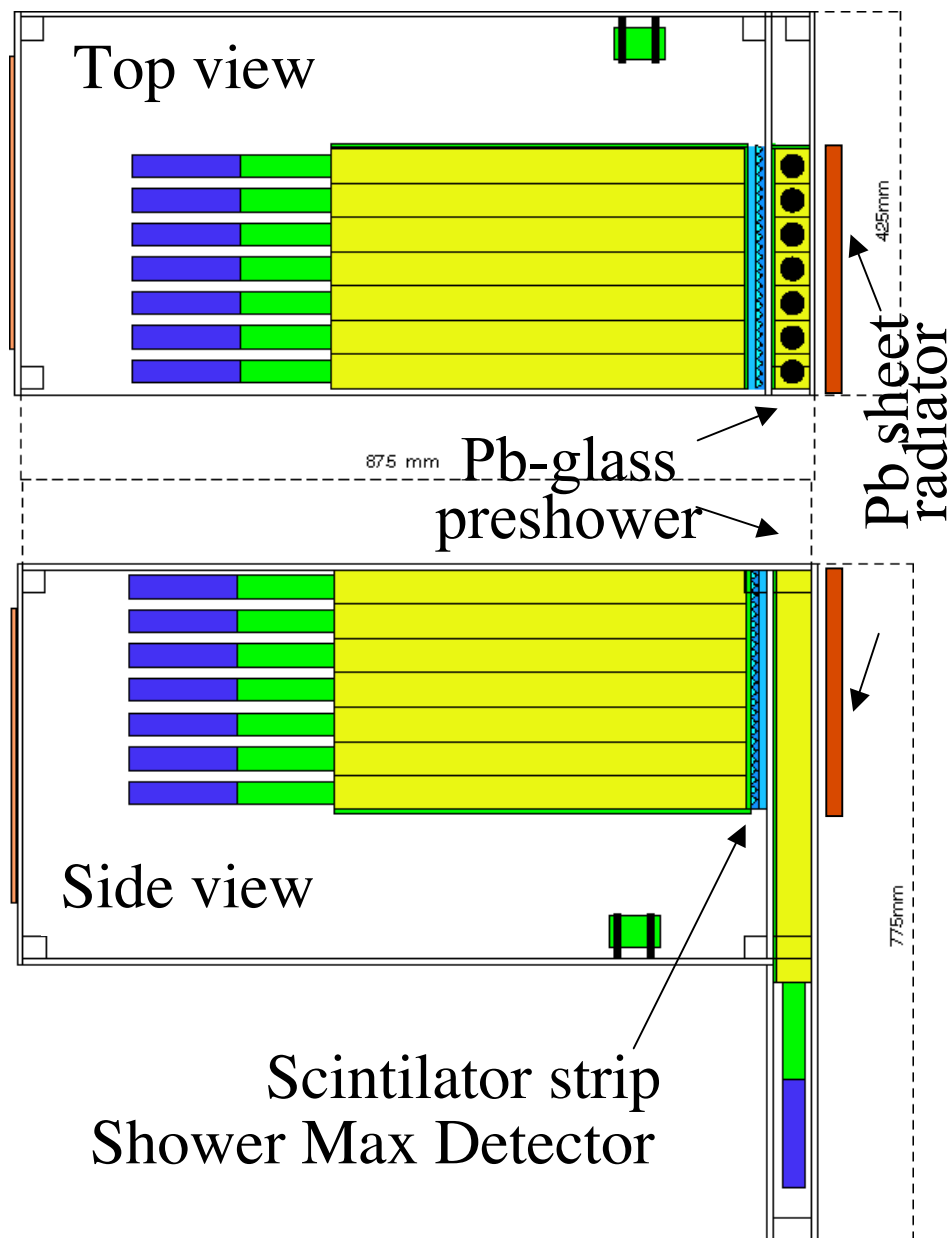
Left-right and top-bottom symmetric, both east & west

Bigger acceptance (compare to last year 4 by 4 Pb-G)

Read by bunch sorted scalars, fast trigger daq, as well as STAR daq



FPD Upgrade Calorimeter Module



Left/right calorimeter modules...

- 49 (7×7 matrix) 3.7 × 3.7 × 46 cm³

Pb-glass + PMT + base (IHEP, Protvino) for main calorimeter

- Two orthogonal 48-strip scintillator shower maximum detectors (SMD) + 6 Hamamatsu H6568 multi-anode PMT's for readout.

- 7 Pb-glass active preshower detectors

- Light-tight box housing main calorimeter + SMD

Up/down calorimeter modules...

- 25 (5×5 matrix) 3.7 × 3.7 × 46 cm³

Pb-glass + PMT + base (IHEP, Protvino) for main calorimeter

Summary

- Very interesting physics with FPD
 - Spin physics :
 - Continue on $A_N^{\square 0}$
 - $x_F < 0$, $\sqrt{s} = 500 \text{ GeV}$, away side ...
 - And beyond
 - Physics at d-A collisions
- Tune spin rotator - required for A_{LL}
- Upgrade of FPD at STAR under way